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BUCHANAN TS
SOIL INVESTIGATION FOR
115 kV OH/ AND U/G TRANSMISSION LINE

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A soil investigation was carried out for the proposed anchor tower outside the station fence and a short stretch of U/G cable route within the station area. This report contains the results of field and laboratory test data with recommendations for the design of foundations for the anchor tower and thermal backfill for the underground cables.

INTRODUCTION

At the request of Stations Projects through the Geotechnical and Hydraulic Engineering Department, a soil investigation was carried out for a short stretch of overhead and underground transmission line in and around the station area.

One borehole was put down to a depth of 11 m just outside the station fence and 2 shallow boreholes were put down inside the station along the proposed 115 kV U/G XLPE cable route.

These locations were marked by the station's staff as per the drawings. The field work was performed between December 6 to 8, 1988. The laboratory testing was completed on December 20, 1988.

ANCHOR TOWER

Figure 1 shows the soil profile as determined by the field log of the deep borehole and the results of laboratory analysis of the soil samples. The soil types encountered at this location are predominantly sandy silts in compact to dense state. The standard penetration values ranged from 20 to 55. Ground water was encountered at a shallow depth of 1.5 m and caving conditions were identified in this wet sandy silt deposit.

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Augered footings are considered feasible provided the hole is cased with a temporary liner and bentonite slurry is employed to prevent the hole caving and sand piping.

U/G CABLE

Tables I and II summarize the soil description and the thermal resistivity values obtained by laboratory tests on tube samples. No in situ thermal resistivity tests were performed due to the high gravel content of soils. The soils along the proposed cable route are predominantly sandy silts and silty sands with varying proportions of gravel.

The soil moisture within the cable embedment depth varied from 5 to 20 per cent by dry weight. The low moisture contents were associated with high gravel content. Free water and wet conditions were encountered at about 1.5 m depth. At Borehole 2, the samples could not be retained in the sampling tube and therefore the thermal resistivity measurements were made on reconstituted samples.

The soils encountered along the cable route were grouped into two categories: (i) fine sandy silt with low gravel content and ii) coarse sandy silt with high gravel content.

Figures 2 and 3 show the results of stage-dry thermal resistivity measurements. These plots show the characteristic curves of thermal resistivity as a function of moisture content. The thermal resistivity values corresponding to the current (in situ) moisture level range from 50 to 60^{o}C cm/w. By performing a soil moisture balance analysis and using the statistical weather data for the London area, the worst case thermal resistivity of 110 to 120^{o}C cm/w is estimated for a return period of 50 years. This estimate is based on an assumption of vegetation cover contributing to depletion of soil moisture by transpiration.

In view of the fact that there is no vegetation cover along the proposed cable route within the station area, a design value of 100^{o}C cm/w is recommended for the native soils. Crushed limestone screenings or a fluidized thermal backfill as per the Ontario Hydro Specifications L-040M and LPS-X4S25200-2001-85 should be used for embedding the XLPE cables at this site.

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TABLE I

Summary of Laboratory Test Results on Soil Samples for Buchanan TS U/G Cables
BH-1; Ch: 1+09.647

PROJECT	REMARKS
BH-1, Buchanan U/G Cable	2-7/8" Shelby for T/R Tests

	SAMP. NO.	LABORATORY SOIL CLASSIFICATION	NAT. DENS. kg/m^3 (x .062 =PCF)	NAT. M.C. % DRY WT.	THERMAL RESISTIVITY ^oC cm/W	CONSOL.	PERM. cm./s AT 20°C	ATTERBERG LIMIT L.L.	P.L.	P.I.
	1	DEPTH - m 0.0 | 0.3 — Shelby — Grey fine to coarse sandy silt with pieces of gravel changing to fine brown sandy silt.	1847	5.5						
	2	DEPTH - m 0.3 | 0.6 — Shelby — Fine brown sandy silt.	1556	15.3	52					
	3	DEPTH - m 0.6 | 0.9 — Shelby — Fine brown sandy silt.	1898	13.8	55					
	4	DEPTH - m 0.9 | 1.2 — Shelby — Brown fine to coarse silty sand and gravel.	1890	5.3	55					
	5	DEPTH - m 1.2 | 1.5 — Shelby — Brown fine to coarse silty sand and gravel till.	2094	11.0						

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TABLE I (cont'd)

PROJECT	REMARKS
BH-1, Buchanan U/G Cable	

	SAMP. NO.	LABORATORY SOIL CLASSIFICATION	NAT. DENS. kg/m^3 (x .062 =PCF)	NAT. M.C. % DRY WT.	THERMAL RESISTIVITY ^oC cm/W						CONSOL.	PERM. cm./s AT 20°C	ATTERBERG LIMIT		
													L.L.	P.L.	P.I.
	6	DEPTH - m 1.5 1.8 Shelby													
		In cartons - fine brown sandy silt (wet) with		15.8											
		some gravel.													
		DEPTH - m													
		DEPTH - m													
		DEPTH - m													
		DEPTH - m													

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TABLE II

Summary of Laboratory Test Results on Soil Samples for Buchanan TS U/G Cables
BH-2; ch: 1+77.650

PROJECT	REMARKS
BH-2, Buchanan TS U/G Cable	Thermal Resistivitity Tests on Reconstituted Samples

	SAMP. NO.	LABORATORY SOIL CLASSIFICATION	NAT. DENS. kg/m³ (x .062 =PCF)	NAT. M.C. % DRY WT.	THERMAL RESISTIVITY °C cm/W						CONSOL.	PERM. cm./s AT 20°C	ATTERBERG LIMIT		
													L.L.	P.L.	P.I.
	1	DEPTH - m 0.0 | 0.3 Shelby													
		Brown fine to coarse silty sand and gravel.		5.0		60									
	2	DEPTH - m 0.3 | 0.6 Shelby in carton													
		Brown fine to coarse silty sand and gravel changing		18.0		52									
		to fine brown sandy silt.													
	3	DEPTH - m 0.6 | 0.9 Shelby in carton													
		Fine brown sandy silt.		19.4		50									
	4	DEPTH - m 0.9 | 1.2 Shelby in carton													
		Fine brown sandy silt (wet)		20.9		52									
	5	DEPTH - m 1.2 | 1.5 Shelby in carton													
		Fine brown sandy silt (wet)		20.8											

TABLE II (cont'd)

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PROJECT	REMARKS
BH-2, Buchanan TS	

	SAMP. NO.	LABORATORY SOIL CLASSIFICATION	NAT. DENS. kg/m³ (x .062 =PCF)	NAT. M.C. % DRY WT.	THERMAL RESISTIVITY °C cm/W	CONSOL.	PERM. cm./s AT 20°C	ATTERBERG LIMIT L.L.	P.L.	P.I.
	6	DEPTH - m 1.5 1.8 Shelby								
		Fine brown sandy silt (wet)		20.0						
		DEPTH - m								
		DEPTH - m								
		DEPTH - m								
		DEPTH - m								

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PROJECT: BUCHANAN TS 115 kV ANCHOR — HOLE TYPE: AUGER (Hollow Stem) — OBSERVER: D. FRASER

LOCATION: OUTSIDE STATION FENCE TOWER — HOLE SIZE: 4" — COMPILED: D. FRASER

DIP: — DRILLED: DEC 6/88 — CHECKED:

DATUM: — BEARING: — DRAWN: DEC 22/88 — APPROVED:

BORING DATA						BORING LOG	WATER INF.		FIELD TESTS		LABORATORY TESTS				
SCALE - METRES	ELEV / DEPTH	(1) SAMPLE NO	(2) SAMPLE TYPE	(3) 'N' VALUE per 0.3m / RQD - %	(4) WATER LEVEL and CAVING W.R.	(5) DESCRIPTION / (6) REMARKS	(7) OBSERVATION WELL DATA	(8) 'k' soil/rock cm/s WATER PRESS. TEST	(9) SPECIAL TESTS TYPE	(9) SPECIAL TESTS RESULTS	NATURAL DENSITY kg/m³	MOISTURE CONTENT - %	(10) SHEAR STRENGTH kPa TYPE	(10) SHEAR STRENGTH kPa RESULTS	(11) SPECIAL TESTS TYPE	(11) SPECIAL TESTS RESULTS
1						*Topsoil (0.2 m) Overyling FINE SAND*										
2		1A	X	20		*Compact, Brown SANDY SILT (Wet)*						25.6				
3																
4		2A	X	58		*Very Dense, Grey SANDY SILT*						17.6				
5		3A	X	53		*Very Dense, Greyish, Brown SILTY SAND*						19.4				
6																
7		4A	X	25		*Compact, Fine Grey SILTY SAND*						21.6				
8		5A	X	19		*Compact GREY SILT with Little Fine Sand*						19.0				
9																
10		6A	X	23		*Compact Grey SANDY SILT*						22.7				
11		7A	X	44		*Dense Grey SANDY SILT*						19.0				
						END OF BOREHOLE										

Notes:

1) *Borehole Backfilled on Completion*
2) *Hole Caved at Approx. 2 m.*
3) *Water Level at Aprrox. 1.5 m.*

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GEOTECHNICAL DATA SHEET — hole no — Fig 1 — sheet

200982-RD

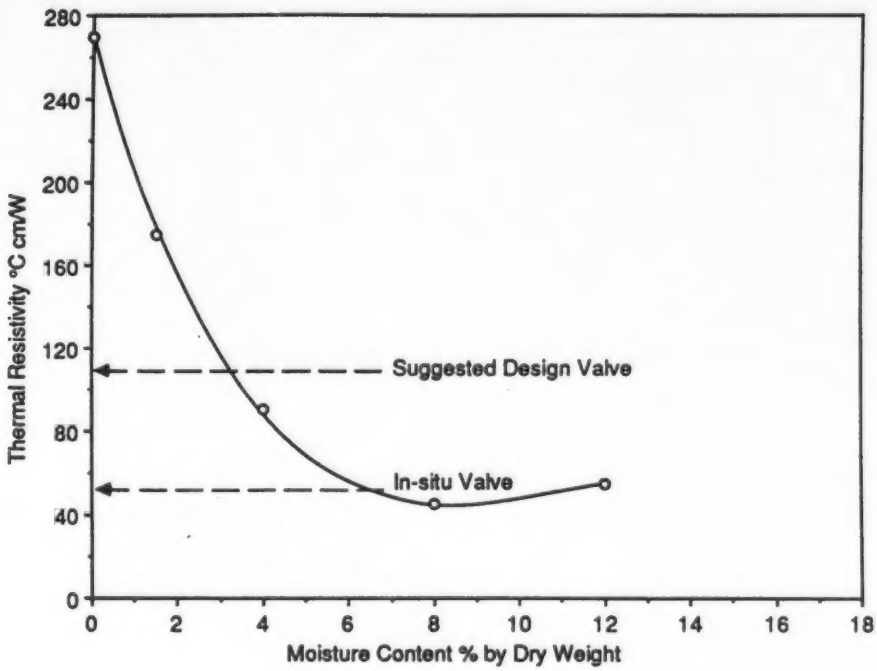

FIGURE 2

THERMAL RESISTIVITY VS. MOISTURE CONTENT CURVE
BUCHANAN TS U/G CABLES
Stage Dry Tests
BH-1 } S-3, 4, 5
BH-3 } S-3
Brown Fine to Coarse Sandy Silt with Pieces of Gravel

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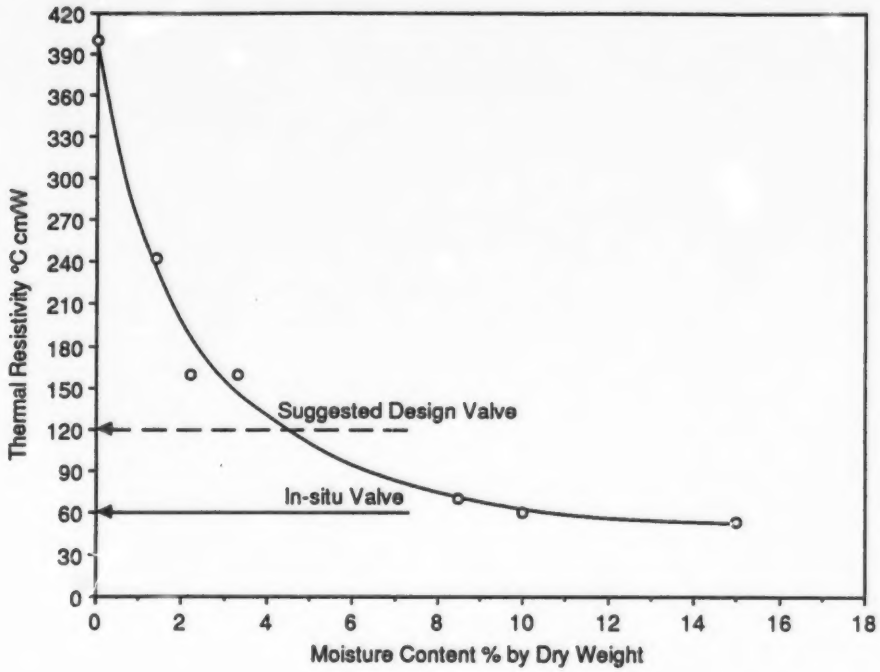

FIGURE 3

THERMAL RESISTIVITY VS. MOISTURE CONTENT CURVE
BUCHANAN TS U/G CABLES
Stage Dry Tests
Sandy Silt Samples
BH-2 } S-2, 3, 4, 5, 6 (1.0' - 6.0')
BH-1 } S-2